# Space Weather Technical Forecast

Issued on Friday, 05 November 2021 at 00:22 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

## Space Weather Forecast Headline: Slight chance of M-class flares. Slight chance of G1-G2 geomagnetic storms. Active electron flux and fluence expected.

## Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** There are numbered two sunspot regions on the visible disc with observed solar activity remaining at Low levels with occasional C-class flares over the past 24 hours. AR2891 (Cai/Beta-Delta) remains the most complex region, with a delta spot in its trailing penumbra. However, over the past 24 hours there has been some slight reduction in overall size, and decay in its lead/trailer spots. AR2893 (Hsx/Alpha) in the northeast quadrant appears stable with very little recent activity. There is a new region currently rotating onto the southeast limb, which appears to have produced the strongest flare during the past 24 hours; a C3.5 flare which peaked at 04/1055 UTC.

No Earth-directed CME's are currently expected.

**Solar Wind / Geomagnetic Activity:** The CME which was observed leaving the Sun early on the 2nd November arrived at Earth around 03/2000 UTC, and over the past 24 hours the solar wind parameters have indicated the initial effects and then the waning influence from this CME. The solar wind started the period at strong levels, around 780 km/s, and peaked at 817 km/s at 04/1040 UTC, then gradually declined to end the day at elevated levels near 580 km/s. Density was initially at average levels, but increased to a maximum of 21 ppcc (above average), before decreasing to around 10 ppcc. Total IMF, Bt, was predominantly strong through the morning, occasionally peaking at 23 nT, before settling to generally moderate levels through the afternoon and evening. The north-south component, Bz, had a long negative period through the morning, starting around 04/0400 UTC at moderate levels before becoming strongly negative, with a peak value of -18 nT at 04/0820 UTC. In contrast to this the Bz became neutral and then positive from midday onwards. Phi angle was mostly positive (away from the Sun) with only brief negative (towards the Sun) fluctuations. G2/Moderate (Kp 6) to G3/Strong (Kp 7) geomagnetic activity was recorded 04/0000-0900 UTC, followed by a G4/Severe storm (Kp 8) interval 0900-1200 UTC. After 04/1200 UTC the geomagnetic activity quickly decreased, ending the day at Quiet levels (Kp 2).

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained slightly elevated but below the S1 level. The high energy electron flux (greater than 2 MeV) was mainly at background levels at first, then steadily increased to end the day at Moderate levels. The associated 24-hour electron fluence was below the Active (1e8 integrated pfu) threshold, but with a noticeable rising trend from midday, with 2.26e7 integrated pfu recorded at 05/0000 UTC.

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# Met Office Space Weather Technical Forecast

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar activity is forecast to remain mainly low through the next four days, but with a continuing chance of M-class flares.

**Solar Wind / Geomagnetic Activity:** Solar wind speeds are currently at elevated levels (around 580km/s). As the effects from the CME wane over the coming days a gradual reduction in speeds is anticipated, reaching slightly elevated or background levels. Geomagnetic activity is expected to be predominantly Quiet to Active (Kp 2-4) today and tomorrow (5th and 6th), with a chance of G1/minor to G2/moderate storms (Kp 5-6). From day 3 (7th) Quiet to Unsettled (Kp 2-3) conditions are expected.

**Energetic Particles / Solar Radiation:** The high energy (greater than 10 MeV) proton flux is expected to remain below the S1 minor storm level. The high energy electron flux (greater than 2 MeV) will start at moderate levels, but is likely to reach high levels at times today (5th) and then predominantly high levels from tomorrow (6th) onwards. Corresponding 24 hour electron fluence values are expected to start below the Active (1e8 integrated pfu) level, but with an increasing trend, with the Active threshold expected to be breached late today, and thereafter remaining above the threshold.

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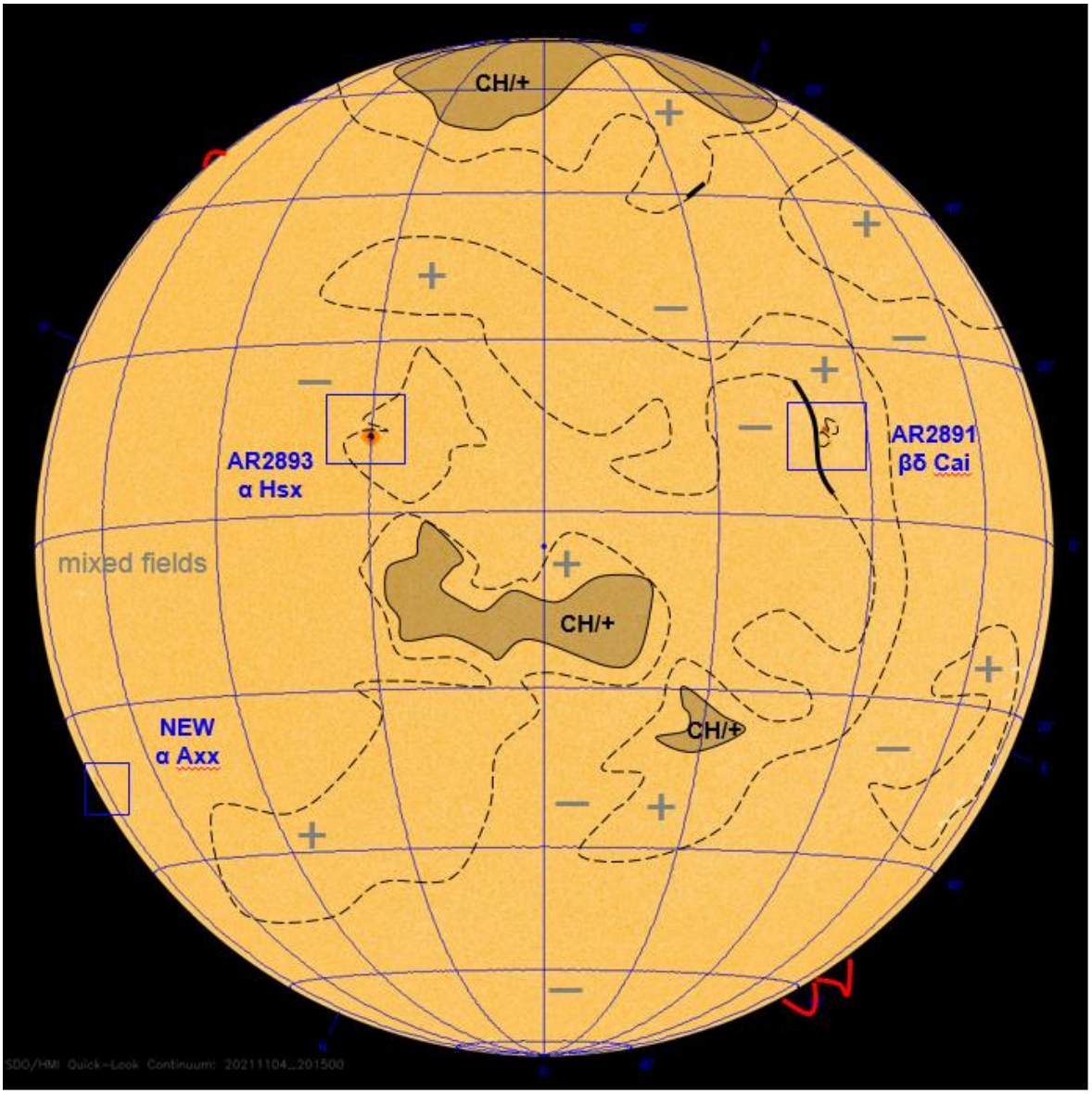
**Figure 1. Solar Analysis Valid 04/2000 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

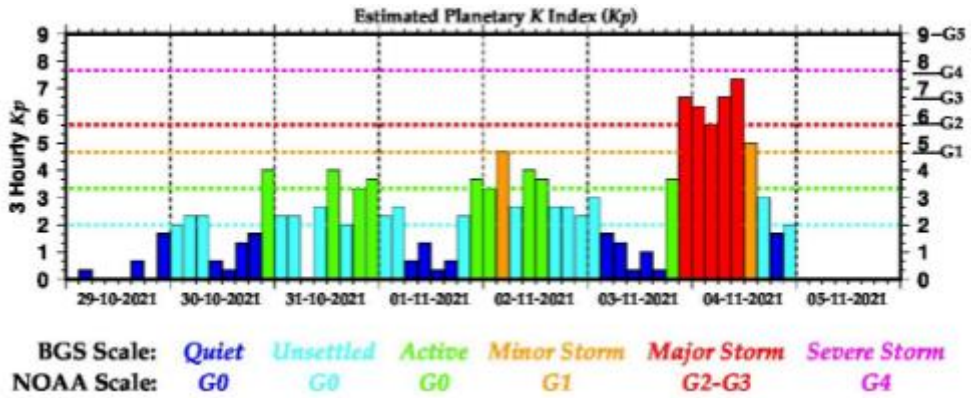
Since the arrival of the CME the solar wind environment has stabilised over the past 12 hours, with currently Quiet geomagnetic conditions. However, the solar wind remains elevated, therefore any prolonged periods of negative Bz would quickly lead to an increase in geomagnetic activity. Currently predominantly Quiet to Active activity is expected, but further G1/Minor to G2/Moderate geomagnetic storms are still possible, especially today.

No other significant coronal hole influences or CMEs are expected, leading a decreasing risk of geomagnetic storms after day 2.

Geomagnetic activity is currently at G4/Severe Storm levels. Activity is expected to reduce on day 1 (4th) and day 2 (5th) back to Active/Kp4 to G2/Moderate storm levels with a chance of an isolated G3/Strong storm interval. By days 3 and 4 (6th and 7th) activity is expected to be Quiet to Unsettled with a slight chance of Active intervals.

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | Yes | 20 | 10 | 5 | 1 |
| Strong | G3 | Yes | 5 | 1 | 1 | 1 |
| Severe | G4 | Yes | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Figure 2: Kp date from the British Geological Society.**

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# Met Office Space Weather Technical Forecast

## Radio Blackouts - X-Ray Flares:

There are numbered two sunspot regions on the visible disc: AR2891 (Cai/Beta-Delta) remains the most complex region, with a delta spot in its trailing penumbra. AR2893 (Hsx/Alpha) in the northeast quadrant appears stable with very little recent activity. There is a new region currently rotating onto the southeast limb, which appears to have produced the strongest flare during the past 24 hours; a C3.5 flare.

Solar Activity from the numbered regions on the visible disc is expected to be at Low levels, but with a slight chance of isolated M-class flares from AR2891. However, due to the arrival of the new region on the southeast limb, which appears to be relatively active already producing C-class flares, the issued probabilities of flares have been increased to above the pure raw statistics.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 20 | 20 | 20 | 20 |
| Very Active | R3 to R5 X Class | No | 2 | 2 | 2 | 2 |

## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is now below S1/Minor storm levels. However, further minor enhancements from significant flaring remain possible.

| Radiation Storms | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ S1 | No | 10 | 10 | 5 | 5 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

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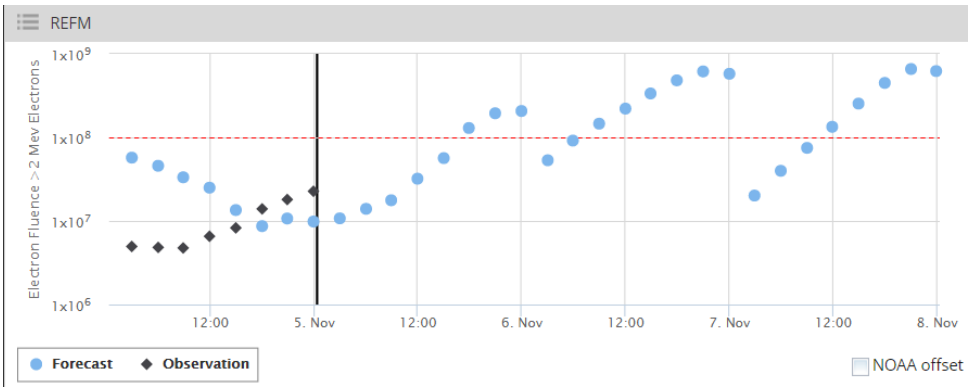
## High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) will start at moderate levels. However, as a result of the recent strong solar wind speeds, and current elevated wind speeds, the flux is likely to reach high levels at times today (5th) and then predominantly high levels from tomorrow (6th) onwards. Corresponding 24 hour electron fluence values are expected to start below the Active (1e8 integrated pfu) level, but with an increasing trend, with the Active threshold expected to be breached late today, and thereafter remaining above the threshold.

Therefore the Met Office REFM model is considering to giving good guidance.

| GEO Electron Environment | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1x10^8$ | No | 70 | 90 | 100 | 100 |
| Very Active | ≥ 2 MeV ≥ $1x10^9$ | No | 1 | 10 | 20 | 20 |

## Figure 3: Met Office REFM model

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